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*PHYSIOLOGY IN THE SCHOOLS.**

THAT some knowledge of physiology and hygiene should form a part of the education of every human being will, I think, be granted by every one who believes that wisdom is safer than ignorance, that ignorance is not innocence, and that health and manly and womanly vigor are better than nerveless helplessness, and lastly that a knowledge of what the Creator pronounced 'very good' is worthy the contemplation and thought of man. It is not necessary, however, to enter into an extended defense or advocacy of physiology and hygiene in the schools; they are there already by the sanction of the people and their representatives in the State Legislature, and hence the real question upon which thought and discussion should be directed is: How can this study be made to yield the best results of which it is capable? The question is apparently easily answered by saying: Put good text-books in the pupils' hands, and supply capable teachers and ample time and facilities. While such an answer may seem sufficient, it is in the present state of educational progress only hollow sound. What is really needed is a discussion of what makes a good text-book, how earnest men and women may become capable teachers, and how facilities, often inadequate, and time mostly too limited, may be best utilized.

* A paper presented at the Thirty-fourth University Convocation of the State of New York, June 24, 1896.

As to the text-books—and there are many of them of various grades of excellence—none seem to me to come up to the standard which should be striven after. The defects are due either to an author's imperfect knowledge of modern physiology or to unfamiliarity with the actual needs of the school room. I believe no truly great text-book for school, college or university can be created out of hand. It must be an evolution, a growth in its natural environment, the school room or laboratory where the pupils can help the teacher by their questions and difficulties. The atmosphere must be one of freedom for learner and teacher. Books written by so-called 'experts,' under the *supervision* of the scientific department of a temperance organization, may, it is admitted, make the subject 'very exciting and entertaining;' that is not what is here advocated, however, but a book by a teacher who, on the one hand, is truly an expert in the grade of schools where the book is to be used, and on the other, the possessor of a knowledge of physiology at first hand; that is, he must have a knowledge that is recognized as expert by the physiologists of the world, then he must write under the *supervision of* his own conscience, not that of an organization.

It is a truism which cannot be repeated too often or too emphatically that one cannot teach what he himself does not know. Therefore, for the teacher of physiology the first requisite is knowledge. Knowledge from books and of books and monographs, but greater than all book learning is knowledge at first hand from nature herself. Such knowledge has the precious quality of being alive, of being the leaven to vitalize the whole lump of knowledge obtained from books, and it makes teaching an inspiration to both teacher and pupil. Such information can only be acquired by the expenditure of considerable time and money. A six weeks' course will hardly accomplish it, although I hasten to add that a term at a university summer school or at a sea-side laboratory where the instruction is given by original investigators will give an uplift and inspiration to an earnest teacher that will be of inestimable value.

But, given the suitable text-book and the capable teacher, *what* shall be taught and *how* shall it be taught? The question of instruction upon the effects of alcohol and other narcotics need take but a sentence, for the subject has been most ably treated by President Jordan and discussed by our Superintendent of Public Instruction, Charles R. Skinner, and others. If I rightly understand them, my view corresponds with theirs and with those of my honored teacher, Prof. Burt G. Wilder, who is to discuss this paper. It is, in a word, to tell the truth, to present fairly both sides of the question, so that when the pupils use their own eyes and put the statements to the test of experience, as most of them surely will, they may feel, as well as know theoretically, that the statements made are true, and the teacher's earnest counsel is reasonable and not merely lurid sentiment.

Another problem will confront the teacher, prepared as indicated above; that is the experimentation upon living animals for the purpose of instruction in the schools. If he has the knowledge requisite he will know that, excepting a few facts, all which is known of physiology and hygiene has been acquired by experimenting upon living animals or living human beings. If one stops for a moment to reflect, physiology deals with the functions or activities of living organisms; it has to do with the living, not with the dead. For example, how shall one know whether a plant is good for food, whether it is medical or poisonous? Of two white crystalline substances, like chlorid of sodium (common salt) and chlorid of mercury (corrosive sublimate), how is one to know that one is almost indispensable for

health and well being in both man and animals, while the other is deadly to both and also to plants? Certainly the desired information cannot be gained by the chemist's test tube or by application to a dead animal. How are the splendid results of the modern physiological psychology being attained? Not by dissecting the dead, but by experimentation upon the living.

Shall our schools then become the 'chambers of horrors' described by the anti-vivisectionists? Heaven forbid! The fundamental facts of physiology, those most intelligible and useful for the pupils in the schools, can be demonstrated for them and by them without the infliction of pain or even discomfort; and most of them can best be performed by the pupil upon himself. Let us take a few examples: Every child knows that there is feeling, as he calls it, in the skin; he also knows the sensation of cold. But he, and indeed most grown people, do not know that the tactile sense does not reside in every part of the skin, and so of the temperature sense. If some object like the rounded end of a lead pencil or a bit of steel be drawn carefully over the skin, say upon the back of the hand, it will be felt simply as an object over the tactile areas, while over the temperature areas there will be a sensation of cold. Then how easy it is to give the real physiology of muscle by having each pupil perform some definite movements of the arms. If the muscles are felt during these movements, especially if some force is exerted, as in lifting a weight, the changes in the form and consistency of the muscles can be easily determined. It will also probably be a revelation to the pupil to find that in raising the arm, for example, the muscles around the shoulder and at the elbow, which by themselves would tend to lower the arm or draw it outward or inward, also contract. After such an experiment it will not be difficult for the pupil to understand that, for the steady and definite movements of parts where the joints give considerable freedom, it is necessary that there should also be a moderate contraction of antagonistic or opposing muscles which by themselves would cause movements in other directions; that is, he will gain, by such a simple experiment, the ground idea of coordination.

Perhaps none of the experiments that can be performed are of more practical utility than some simple ones in digestion. It is now very easy to obtain from the pharmacies the ferment of the stomach or of the pancreas. With these ferments and a glass vessel the pupils can see for themselves the solvent action on various forms of food. They can see that finely divided food is more quickly dissolved than large masses, and hence one of the principal advantages of thorough mastication. So if the ferment of the saliva or pancreas were mixed with raw starch and with cooked starch it could be seen, with a distinctness never to be forgotten, that fire is a powerful ally of the human digestive organs. These experiments are also instructive because the processes are practically identical with those going on in the living body, and thus illustrate the side of physiology that may be demonstrated without experimenting on a living organism.

The circulation of the blood is a fact of such fundamental importance and so interesting in itself that every student ought to have the privilege of viewing it under a microscope. This can be very easily shown in the web of a frog's foot or in the external gills of a water salamander like the Necturus. If a little ether is put in the water containing the animal it will soon become anæsthetized without interfering with the circulation. The ether will render the perfectly painless observation successful without even arousing the apprehensions of the animal, which soon revives when placed again in fresh water, and appears as happy

as if nothing had occurred. The experiment will also illustrate in a striking manner the effect of anæsthetics on all living beings. A very far-reaching lesson may be given by having each pupil perform some of the simpler experiments showing the illusions of the senses; these are so graphic that the dullest cannot fail to appreciate the fact that the only safe way is to look on all sides, to verify appearances by applying as many tests as possible—in short, to appreciate the *scientific method* which is so tersely expressed in the words of Scripture, "Prove all things; hold fast that which is good."

So far nothing has been said about anatomy. What place shall it have in a course upon Physiology? Undoubtedly it is a very great help in the study of function to have a good knowledge of the structures performing the various functions; but it seems to me that in many books, and in some courses in physiology, anatomy is so preponderant that the physiology is too much lost sight of—that is, the mechanism is exalted above its achievements. Only the grossest functions of the organs, like the supportive action of the bones, can be deduced from the anatomy alone; yet it is certainly the fact that, after the physiology has been once determined by experiments upon living beings, one can often see how admirably the structure of an organ is correlated with the performance of its function. For example, the small intestine with its millions of villi projecting like so many rootlets into the digested food seems from its very structure destined for absorption.

On the other hand, if one studied never so profoundly the structure of the salivary glands and the pancreas he would never know that they produce digestive liquids without experiment, and much less would he know that the one is so limited in its power (saliva) and the other so unlimited and powerful as a digester. So I think the microscopic structure or histology is liable to be made too much of in elementary books and teaching. But, for a few points, the microscope is truly a revealer; *e. g.*, the mystery of the current by which the air passages are swept clean of dust and other particles is simplified by microscopic observation which shows the tireless multitude of cilia with their ceaseless waving. The fact is not to be forgotton, however, that even in this case only the minute agents and their method of work have been found. *Why* they work is as great a mystery as ever. So also in the study of the circulation of the blood under the microscope one can see how closely every living element is surrounded by the blood capillaries, and how ceaselessly the blood corpuscles and the plasma move along, to be followed by a never-ending fresh supply.

The purpose of this paper has not been unduly to criticise, but to throw out what I hope will prove to be a few helpful suggestions. That the efforts of the teachers of this State are earnest and devoted is thoroughly believed. That the pupils they instruct are not all acquainted with sufficient anatomy and the fundamental principles of physiology is also known by the examinations for entrance in the University in which I have the honor to teach. From carefully compiled statistics obtained during the last few years it is found, however, that the pupils who have studied physiology something in the way indicated above have been far more successful than those who have merely studied the books.*

* Facts concerning entrance examinations in physiology at Cornell University: The great majority of students enter in physiology with the other studies, from Regents' diplomas or from graduation at accredited schools.

From the reports of the President and Dean it was seen that about one in sixteen so entering could not remain in the University on account of defective scholarship, while of those taking entrance examinations

If in closing I may briefly epitomize, it seems to me, that the best results may be obtained in physiologic instruction in the schools as follows:

1. Text-books written by able teachers who know the subject at first hand should be provided.

2. The fact should be emphasized that physiology is very real, and that every one may demonstrate upon himself many of the most striking and fundamental phenomena; for example, how quickly will the pupil see that it is not necessary to go to the teacher or to the book to find out the number of heart-beats and respirations per minute, and that both are greatly accelerated by exercise or excitement.

3. Anatomy should not overshadow physiology, but nice structural adaptations whereby specific functions are performed may be pointed out and worked upon with great advantage; for example, the valves in the heart, the veins and lymphatics, the forms of the joints, etc. Such knowledge is interesting and would aid all. Perhaps also it might arouse some slumbering genius whose future efforts would reveal adaptations now hidden.

4. The teacher should inspire his pupils with respect for the human body and its powers, and with due sympathy for all living things. Lastly, he should impress upon them with solemn earnestness the fact that their physical and moral health is largely in their own hands, and that the physical and moral laws of their being are inexorable.

SIMON HENRY GAGE.
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at the University one in eight was dropped, showing that the more poorly prepared were those who came for examinations including physiology. Physiology papers of 195 of the latter class have been looked over with reference to determining the quality and kind of preparation made, as taken from answers to questions.

The average standing of the 195 was.....53%
The average standing of those having dissection and drawing.....59%
The average standing of those having nothing but books.....47%
The average standing of those self-prepared.....59%
The average standing of those having previous college training.....66%

DISCUSSION OF PROF. GAGE'S PAPER ON PHYSIOLOGY IN THE SCHOOLS.

IT is fitting that the address on physiologic instruction should be given by a Cornell professor. For, in 1868, at the suggestion of the first president of that institution (the Hon. Andrew D. White) the entire Freshman class attended a course on physiology and hygiene during the first term; the examination questions were such as were asked in medical schools at that time, and diagrams were required of both macroscopic and microscopic structures. The choice of the speaker was equally happy; for the year of his graduation, 1877, was memorable in the annals of Cornell, in that then first physiology became a requirement for admission. Furthermore, Prof. Gage is a master in the elucidation of the fine anatomy of animal tissues which aids so materially the comprehension of function, and his address last summer as President of the American Microscopical Society, 'A Plea for Physiologic Histology,'* well merits mention in this connection.

If I commence with an emphatic corroboration of his complaint as to the inadequacy of existing text-books, it is because no other want has been more constantly and keenly felt by me during the twenty-eight years in which I have delivered 40 courses of lectures upon physiology (one-fourth of them in medical schools), and have addressed upon the subject more than 4,000 individuals.

From the nature of the case a text-book can never be *complete*. But the other four of what I call the five C's may surely be

*SCIENCE, August 23, 1895.

attained, viz., it should be *correct* so far as it goes and so far as existing knowledge permits; it should be *concise*, *consistent* and, above all things, CLEAR.

For use in systematic instruction the textual form of a scientific manual should be neither that of a treatise to be perused nor that of a lecture to be spoken. The paragraphs should be short, categoric and visibly, as well as logically, coordinated and subordinated.

It is probable indeed that one of the grounds for the success of mathematics and linguistics as disciplinary studies is the relative perfection of their pedagogic methods, and especially the way in which the general rules and exceptions thereto are set forth.

As to the *writer of a text-book*, if the book fulfills the requirements perhaps its source is of little moment. But even if this be not conceded I fear the limitation indicated by Prof. Gage is practically unattainable. With the absolute convictions natural to comparative youth, he is perhaps so sure that "a little knowledge is a dangerous thing" as to forget that, if that pithy saying be strictly true, no one of us can regard himself as altogether safe. Indeed, it is now many years since any one person could obtain *all* physiologic information at first hand. I trust, therefore, that Prof. Gage may assent to this less stringent statement: The writer of a text-book should have made some real contribution to physiologic method, fact or idea.

Like the teacher, the writer of a text-book needs to guard against the temptation to subordinate the needs and capacities of the learner to the supposed necessity for exhibiting his own erudition. The wisest of teachers is he who knows just what to omit.

In general method there is too often a direct inversion of the natural order. Children should be led to sing before they talk; they should be taught to draw before they write; and they should be encouraged to *observe* before they are compelled to think. In observing and reflecting they should be neither pushed nor pulled, but guided.

As applied to physiologic instruction, instead of '*verba et præterea nihil*,' or even many words illustrated by a few random demonstrations, there should be numerous and well devised experiments upon which the pupils should reflect and comment. In short, in the place of what may be called *inducation* there should be sought a true *education*. Contrary to the Scripture phrase, the kingdom of science cometh *with observation*.

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GEOLOGICAL ATLAS OF THE UNITED STATES.

FOLIO 16, KNOXVILLE, TENNESSEE–NORTH CAROLINA, 1895.

THIS folio, by Arthur Keith, consists of six pages of text, a topographic sheet, a sheet showing the areal geology, another showing the economic geology, a third giving structure sections, and a fourth giving columnar sections. The folio describes that portion of the Appalachian province which lies between parallels 35° 30′ and 36° and meridians 83° 30′ and 84°. This district contains about 968 square miles, divided between Knox, Sevier, Bland and Jefferson counties, in Tennessee, and Swain county, in North Carolina.

The text begins with a general description of the province, and shows the relation of this part to the whole. The local features of the drainage by the Holston, Tennessee and Little Tennessee Rivers and their tributaries, such as the Little Pigeon and Little Rivers, follow next in description. The various forms of the surface are pointed out, such as East Tennessee Valley, Smoky Mountains and Chilhowee Mountain, and their relations to the underlying rocks are emphasized.

Under the heading 'Stratigraphy' the

geologic history of the Appalachian province is presented in outline, and the local rock groups are fully described in regard to composition, thickness, location, variety and mode of deposition. The formations range in age from Algonkian (?) to Silurian, the greater portion being Algonkian (?). The Silurian rocks appear in the East Tennessee Valley, the Cambrian in Chilhowee Mountain and in various narrow belts in the valley, and the Algonkian southeast of Chilhowee Mountain. The Algonkian rocks are chiefly slates, sandstones, conglomerates and graywackes; the Cambrian rocks consist of sandstones and shales in the Chilhowee belt and of sandstones, shales and limestones in the valley; the Silurian rocks comprise sandstones, limestones and shales. The details of the series of strata are shown in the columnar section. The process of decay in each kind of rock is discussed, and the manner in which the residual soils and forms of surface depend on the nature of the underlying rock.

In the discussion of 'Structure,' after a general statement of the broader structural features of the province, two methods are shown in which the rocks have been deformed. Of these the extreme Appalachian folding is the chief, and less in importance are the broad vertical uplifts. Three degrees of deformation appear in the Paleozoic rocks—folding, faulting and metamorphism—each being best developed in certain kinds of strata. The region northwest of Chilhowee Mountain is broadly anticlinal, while the Smoky Mountain district is synclinal, and two lines of minor uplift appear in each of these districts. Faults are found chiefly on the west side of these minor uplifts, especially in the Cambrian sandstones, and metamorphism increases southeast from Chilhowee Mountain. In the East Tennessee Valley the rocks are folded to an extreme degree and the strata are frequently perpendicular or overturned. In the sheet of sections the details of the folds and faults appear.

Economic products of this region comprise gold and iron ore, ornamental stone, such as marble, such building stone as sandstone, limestone and slate, and other materials, like lime, cement and brick clay. The localities of each of these materials are noted, and quarries are located on the economic sheet, and the nature and availability of the deposits are discussed. The resources of the region which inhere in timber and water power are also described.

FOLIO 19, STEVENSON, ALABAMA-GEORGIA-TENNESSEE, 1895.

This folio, by Charles Willard Hayes, is bounded by parallels 34° 30′ and 35° and meridians 85° 30′ and 86°. It contains 980 square miles, embracing portions of Franklin and Marion counties in Tennessee; Dade, Walker and Chattooga in Georgia; and Jackson, Dekalb and Cherokee in Alabama. The folio contains four pages of text, including a generalized columnar section and four coal sections; one sheet showing topography, another showing areal geology, a third economic geology and a fourth giving five structure sections inserted in the map.

The Stevenson quarter degree is occupied chiefly by the Cumberland plateau and its outliers, Sand and Lookout Mountains. It includes also a portion of Brown's Valley, which is the southward continuation of Sequatchie Valley and is located upon the westernmost of the sharp anticlines which characterize the folded belt of the Appalachians. Extending diagonally across the center of the area is a broad, level plateau, forming Sand Mountain. It is bounded by straight and steep escarpments. To the east are Lookout and Wills valleys, also located upon sharp anticlines. Finally, the southeastern portion of the area is occupied by Lookout Mountain, also a broad, level pla-

teau. Thus there is seen to be a close relation in this region between structure and topography. The valleys are located upon the anticlines and the plateaus coincide with the synclines. This relation depends upon the relation of hard and soft rocks in this region. Of the strata exposed, the upper formations are hard sandstones and the lower generally limestones. After the anticlinal folds had been produced by lateral pressure the region was for a long time subjected to subaëreal erosion. The whole surface was reduced to a nearly uniform plain, now represented by the summits of the plateaus, but then near sea level. Thus the hard sandstone was removed from the tops of the arches, and when the region was elevated the softer limestones there exposed were easily reduced to the lower level, while the surface within the synclines was protected from erosion by the hard sandstones.

The oldest formation of the region is the Knox dolomite, which is brought to light along the axes of the anticlines. Above this is the Chickamauga limestone, from 1,100 to 1,400 feet in thickness, and the Rockwood, which is here a calcareous shale. The Devonian is represented by black, carbonaceous shale from 20 to 40 feet in thickness, and the Carboniferous by Fort Payne chert and Bangor limestone, representatives of the Mississippian series, and the Lookout and Walden sandstones, forming the coal measures. In all about 5,000 feet of strata are exposed, and the formations generally thicken toward the southeast.

The structure of the region is quite simple, and has already been indicated. In addition to the anticlines which were mentioned, there is a fault along the western side of the Sequatchie anticline which brings the Knox dolomite in contact with the Bangor limestone for several miles.

The principal mineral resources of the region are coal and iron ore, while limestone, building and roadstone and brick and tile clay are subordinate but important. The coal-bearing formations are the Lookout and Walden. They occupy the surface of the plateaus, forming 544 square miles, the larger portion of which probably contains workable coal. The only important development of the coal is in Dade county, Georgia, where five beds occur below the conglomerate, at least four of which are workable locally. The chief iron ore of the region is red hematite or fossil ore of the Rockwood formation. This ore is very similar in appearance to that occurring at the same horizon in such widely separated localities as Wisconsin, New York and central Alabama. It has been extensively worked in the vicinity of Rising Fawn, near the Georgia-Alabama line. It is not always of workable thickness, but the economic map shows the areas within which it may be found.

FOLIO 20, CLEVELAND, TENNESSEE, 1895.

This folio, by Charles Willard Hayes, embraces 4 pages of text, a sheet showing topography, another areal geology, and a third economic geology, also a sheet containing five structure sections, and, finally, a sheet giving two generalized stratigraphic sections.

The Cleveland quarter-degree is bounded by the parallels 35° and 35° 30′ and the meridians 84° 30′ and 85°. It contains 975 square miles, including portions of Meigs, McMinn, James, Bradley and Polk counties. The country represented on the Cleveland sheet lies largely in the Appalachian valley. Its northern corner reaches within two miles of the Cumberland escarpment, which forms the western limit of the valley district, while its southeastern corner reaches beyond the limit of the valley, and includes a small portion of the Unaka Mountains, which form the western chain of the Appalachians. When the valley

district is seen from an altitude of 1,000 feet or over, it appears as a broad undulating plain, nearly all the ridges and hills rising to a uniform level a little less than 1,000 feet in altitude. Above this level a few ridges rise some hundreds of feet; below it the Tennessee and Hiwassee Rivers flow in valleys 250 feet in depth. In other words, this portion of the Appalachian Valley may be regarded as a plain on which the higher ridges remain in relief and in which the stream channels have been sunk. A similar plain, having an altitude of about 1,700 feet, stretches along the western base of the Unaka chain. This is much more deeply dissected by narrow stream channels than the lower plain in the valley. These are portions of the two principal peneplains of the southern Appalachian province, formed respectively in Tertiary and Cretaceous time. The greater part of the area is drained by tributaries of the Hiwassee River, which crosses it in a direct course and joins the Tennessee River near the western border. A small part is drained by the Conasauga River, whose waters flow south to the Coosa and thence directly to the Gulf. The divide between the drainage systems is broad and indistinct, and a little below the lower of the two peneplains of the region. From a study of this and adjacent areas it appears probable that during the formation of that peneplain the drainage was very different from that at the present time. Previous to the uplift which caused the streams to cut their present channels in the peneplain, the Tennessee River did not turn westward, as it now does, but continued southward in the valley, across the present divide, directly to the Gulf.

The rocks of the Cleveland quarter-degree fall into three groups: The Ocoee series, the Chilhowee series, and the fossiliferous Paleozoic formations of the Appalachian Valley. Probably the oldest rocks in the region occur in its southeastern corner, forming Big Frog Mountain and the plateau along its western base. No fossils have yet been found in these rocks, and they are separated by a great fault from rocks of known age, so that their position in the stratigraphic column has not been fixed with certainty. However, since they bear all the marks of extreme age, and, so far as known, contain no organic remains, they will be considered Algonkian until satisfactory evidence to the contrary is found. They consist chiefly of graywacke slates, containing many beds of coarse conglomerate and some siliceous limestones.

The Chilhowee series consists of quartzites, sandstones, conglomerates and shales, which form Beans and Starrs Mountains at the southeastern border of the valley. The area of these rocks is separated by faults both from the Ocoee on the east and the fossiliferous valley formations on the west. No fossils have yet been found by which their age can be determined, but they correspond so closely with a series of formations in the Chilhowee Mountains, in which Cambrian fossils have been found, that there can be little doubt that they occupy the same stratigraphic position.

The fossiliferous Paleozoic rocks of the valley embrace three Cambrian formations, made up largely of argillaceous and sandy material. The Knox dolomite, which is from 3,800 to 4,100 feet in thickness, is in part Cambrian and in part Silurian. Above this is the Chickamauga limestone, 1,000 feet in thickness in the western part of the area, and 300 or 400 feet thick in the eastern part, where the upper portion of the limestone is replaced by shales and sandstones, forming the Athens, Tellico and Sevier formations. Finally, above these, is the Rockwood formation, which also shows considerable increase in thickness and in the proportion of coarse material toward the southeast. The Devonian is repre-

sented by 15 to 30 feet of black shale, and the Carboniferous by about 350 feet of very siliceous limestone.

The peculiar structures which characterize the intensely folded belt of the Appalachian Valley are highly developed in this region. The sections show five well-marked synclines west of the Ocoee rocks, with a large number which are less distinct. They are all nearly parallel, crossing the tract in a northeast-southwest direction with slightly curved axes. These synclines usually have gentle dips on their western sides and steep or overturned dips on their eastern. In most cases adjacent synclines are separated by thrust faults. Thus the strata are broken into a large number of narrow blocks which overlap each other, the fault plains all dipping southeastward.

The principal mineral resources of the region consist of iron ore, lead ore, limestone, building and road stone, and brick and tile clay. A small amount of hematite or red fossil ore occurs associated with the shales of the Rockwood formation. Also considerable bodies of limonite occur, chiefly along the great thrust faults which separate the Chilhowee series from the valley rocks. The lead ore is found in limestones at the base of the Knox dolomite, and is mined to some extent a few miles south of Cleveland.

FOLIO 21, PIKEVILLE, TENNESSEE, 1895.

This folio, by Charles Willard Hayes, consists of 3½ pages of text, a topographic sheet (scale 1:125,000), a sheet of areal geology, one of economic geology, another of structure sections, and a final sheet giving a generalized columnar section of the district and vertical sections showing the position and thickness of coal beds.

The quarter-degree covered by this folio has an area of 980 square miles. Its southeastern corner is just within the great Appalachian Valley, and its northwestern corner occupies a portion of the highland rim of Middle Tennessee. It therefore extends entirely across the Cumberland Plateau, whose level surface has here an elevation of about 1,700 to 2,000 feet above tide. The plateau is intersected by Sequatchie Valley, a narrow depression between wall-like escarpments which are parallel with the eastern escarpment of the plateau. This remarkable valley is located upon the westernmost of the sharp anticlinal folds which characterize the great Appalachian Valley belt. The western escarpment of the Cumberland Plateau is extremely irregular, being deeply notched by the streams flowing from its surface.

The two most important peneplains of the southern Appalachians are well developed in this region; the higher and older appears in the surface of the plateaus, and the younger, about 1,000 feet below, forms the hilltops of the Sequatchie Valley and the surface of the highland rim.

The larger part of the surface of the Pikeville quarter-degree is occupied by Carboniferous rocks, the coal measures (Walden and Lookout sandstones) forming the surface of the plateaus, while the Bangor limestone and Fort Payne chert occupy the lower slopes of the escarpments and highland rim to the west. The underlying Devonian and Silurian formations are brought to light by the steep folds of the Sequatchie and Tennessee Valleys. The Devonian is represented by fifteen feet of carbonaceous shale which appears to be entirely conformable with the formations above and below.

Three Silurian formations are represented on the map. The Rockwood, at the top, is composed of sandstone and sandy shale in the Tennessee Valley, but becomes more calcareous toward the west, so that in the Sequatchie Valley it is a shaly limestone, and on the next quarter-degree is indistinguishable from the massive Chickamauga limestone below.

Compared with the Appalachian Valley belt to the east, the structure of this region is simple. Its most striking features are the Sequatchie anticline and fault. On either side the strata are nearly horizontal, forming a broad, shallow syncline on the east, and passing westward with a few low undulations into the great expanse of horizontal strata of the Mississippi Basin.

The most important economic interest in the region is coal. Workable beds occur both in the Lookout and in the Walden formations. The lower beds, those in the Lookout, are variable in position and thickness, so that, while they afford much excellent fuel in places, they are not generally suitable for working upon a large scale. Their character at Bon Air, where they are extensively developed, is exceptional. The most important coal seam in the region, by reason of its greater thickness and uniformity, is the Sewanee, which occurs in the Walden sandstone a short distance above the Lookout conglomerates. Its area, within the limits of the Pikeville quarter-degree, is about 500 square miles, of which the greater portion is workable.

FOLIO 22, MCMINNVILLE, TENNESSEE, 1895.

This folio, by Charles Willard Hayes, consists of 3 pages of text, a topographic sheet (scale 1:125,000), a sheet of areal geology, another showing the economic geology and another giving structure sections. Following the text is a generalized columnar section for the district, accompanied by vertical sections showing the position and thickness of coal beds.

The quarter-degree covered by the McMinnville folio has an area of 980 square miles. It joins the Pikeville and Sewanee quarter-degrees on the east and south. The greater part of its surface is within the highland rim. Its northwestern corner includes a small portion of the central basin of Middle Tennessee, and its southeastern corner is occupied by the Cumberland Plateau. From northwest to southeast, then, the surface rises by steps from the central basin, with an altitude of 700 feet, to the highland rim, at 1,000 feet, and again to the Cumberland Plateau at 1,800 feet. Each step or terrace is part of a more or less perfectly preserved peneplain produced by long-continued erosion, when the land stood relatively lower than now. The plateau, which is the highest and consequently the oldest of these plains, formerly extended far to the westward, but has been worn away by the action of streams during and since the formation of the next lower plain. In the same manner the streams are wearing down the second to the level of the third plain, and the escarpment which separates the two is slowly working backward toward the southeast, following the retreat of the higher plateau escarpment.

The McMinnville quarter-degree lies entirely beyond the westernmost of the sharp folds which characterize the Appalachian Valley belt. Its strata are nearly horizontal, having a very gentle and uniform dip toward the southeast of about 30 feet to the mile. The strata exposed measure only 1,700 feet in thickness, which is but a small fraction of the thickness exposed in regions containing folds. Of these 1,700 feet of strata, about 1,500 are Carboniferous, consisting of coal-measure sandstones and shales, forming the upper portion of the plateau, and limestones forming the lower portions of the plateau escarpments and the surface of the highland rim. Beneath the Carboniferous formations are from 10 to 30 feet of black shale, which appears to represent the whole of the Devonian deposition in this region. The streams in the northwestern corner of the quarter-degree have cut down through the Carboniferous and Devonian, and as much as 200 feet into the underlying Silurian limestone. The upper division of the Silurian on the

eastwardly adjacent Pikeville quarter-degree, the Rockwood shale, becomes so calcareous toward the west that it cannot be distinguished from the underlying Chickamauga limestone. The McMinnville quarter-degree is essentially an agricultural region, the Carboniferous limestones forming a belt of exceptionally fertile soil along the inner portion of the highland rim. It includes a small area of coal-bearing rocks in its southeastern corner, where the subconglomerate beds, probably corresponding to those at Bon Air, have been opened and worked for local consumption.

WORK OF THE UNITED STATES GEOLOGICAL SURVEY FOR FISCAL YEAR, 1896–97.

The Director of the U. S. Geological Survey recently formulated the plan of operations for the bureau under his charge for the fiscal year ending June 30, 1897, and it received the approval of the Secretary of the Interior. As soon as the plans were approved the surveying parties were made up and ordered to the field.

The plan covers all the work of the year, administrative and scientific, and begins with a financial statement. The total appropriation for topographic surveys for 1896–97 is $184,200, an increase of $25,000 over the appropriation for the year just closed. For geologic surveys and researches there is $118,700, which includes an item of $5,000, specifically appropriated for an investigation of the gold resources of Alaska, and for paleontologic work there is $14,000. For chemical researches the appropriation is the same as that for last year, $10,000. For hydrographic work there is an appropriatiou of $50,000, as against $20-000 for 1895–96. For the preparation of illustrations and of the report on mineral resources, the engraving of maps, etc., there is an aggregate appropriation of about $100,000.

In accordance with the plan 30 parties have taken the field or will soon take the field for geologic work, 5 in the New England region, including New York; 5 in the Appalachian region; 2 in the Atlantic Coastal Plain region; 5 in the Interior or Mississippi region; 4 in the Rocky Mountain region, and 8 in the Pacific region. The mining districts of the Appalachian and Rocky Mountain regions will receive special attention, though areal mapping and other work will go on in all directions, as heretofore.

The paleontologists will engage in the determination of faunas and floras, especially those of the coal regions of the Appalachians and Rocky Mountains, and a study will be made of the Cretaceous fauna of Colorado, Utah and Wyoming, with reference to areal and vertical distribution, for the purpose of aiding the geologists in the solution of problems in areal geology. For this work several of the paleontologists take the field.

The appropriation for hydrographic work has been subdivided, so that $25,000 will be devoted to the gauging of streams and the determination of the water supply of all parts of the country, a second sum of $10,-000 to the investigation of the subject of artesian wells and underground currents in arid and semi-arid regions, and the remainder to the preparation of reports upon the methods of utilizing the water resources. Work will be done in nearly every trans-Mississippi State and Territory, as well as in New England, Pennsylvania and most of the Southern States.

Topographic work this year will be under the immediate charge of the Director, and will thus be placed on the same footing in that respect with the geologic work. A highly important change will be in the method of making the topographic surveys, a change which will, it is expected, materially enhance the value and extend the field

of usefulness of the topographic maps. It was provided in the Sundry Civil Act, under authority of which the work will proceed, that levels be established above sea level in every area under survey and that these levels be marked on the ground by iron or stone posts or bench marks. Thus accurate levels will be run everywhere in the course of the surveys and monuments established at short intervals. The work done in this way will progress somewhat less rapidly than it has progressed under the old method. The $25,000 which has been added to the appropriation is expected to meet the cost of doing the work in this way.

There are 30 or 35 triangulation and topographic parties in the field, or about 75 men, all told.

In New York the topographic surveys will be continued on the cooperative basis, the State government having appropriated $15,000, the Federal Survey to allot a similar sum to the work. There will also be cooperation in Maryland.

The joint topographic and land subdivision survey of the Indian Territory, which has been going on without interruption in the field since May, 1895, will be continued to completion. W. F. MORSELL.

THE NEW YORK STATE VETERINARY COLLEGE.

BY the Legislative acts of 1894, 1895 and 1896 for the establishment and maintenance of a State Veterinary College, New York has taken a notable step in advance. The animal industry of the State is so important and extensive, and the relations of animal diseases so intimately interwoven with human health and well-being that every undertaking whereby the financial and sanitary interests of the State will have the benefit of the knowledge and continued investigations of a body of experts must command the approval of every one. It is believed, too, that the establishment of the College upon the campus of a great university with the full advantages of its libraries and laboratories and surrounded by the university atmosphere will be of inestimable advantage to it. On the other hand, it will aid the university to have in its midst a group of investigators and students dealing with the great practical problems involved in the live stock interests of the State and the relations of this industry to public health. In a word, it is believed that the atmosphere of a university will inspire and liberalize the College, and the efforts of the College for the information and betterment of the condition of society will have a like beneficial effect on the university, by bringing clearly before it practical problems and the real efficiency of our present knowledge in dealing with great sanitary and financial interests.

The standard for the veterinarians of New York State is very high, and the State school ought naturally to prepare men well for their profession; it has therefore the duties of a professional school. On the other hand, its purpose being to study and if possible eradicate or show the means of avoiding animal diseases and epidemics, it must also be a center of investigation. For this double purpose of teaching and investigation, it has six special buildings in addition to those of the University; and it is believed that under the wise guidance of its Director, Dr. James Law, who has served the State and the Nation so well and efficiently in the past, that its opening in the coming autumn will mark another milestone of progress in the State. The following have been already appointed upon the staff of the College:

1. For director of the State Veterinary College and professor of veterinary medicine, principles and practice, zymotic diseases and State medicine: James Law, F. R. S. V. S. of Great Britain; professor of veterinary science in Cornell University;

formerly professor of materia medica and anatomy in the Edinburgh new Veterinary College and the Albert Veterinary College; chairman of the United States treasury cattle commission; State veterinarian of New York; consulting veterinarian to the New York State Agricultural Society; chief director of the United States Bureau of Animal Industry for the suppression of lung plague in the Mississippi valley and in New York; member of the tuberculosis commission of the State of New York; chairman of the regents' board of veterinary examiners for New York and author of a 'General and Descriptive Anatomy of the Domestic Animals,' the 'The Farmers' Veterinary Adviser' and numerous monographs on veterinary subjects.

2. For professor of veterinary surgery, obstetrics, zootechny and jurisprudence: (Appointment not yet made.)

3. For professor of veterinary and comparative pathology and bacteriology: Veranus Alva Moore, B.S., M.D.; chief of the pathological division of the United States bureau of Animal Industry, Washington, D. C., professor in the National Veterinary College and of histology in the medical department of the Columbian University, Washington, D. C.; author of numerous bulletins on the pathology and bacteriology of animal diseases, published by the Bureau of Animal Industry.

4. For assistant professor of veterinary and comparative physiology, materia medica and pharmacy: Pierre Augustine Fish, B.S., D.Sc., D.V.S.; assistant in the pathological division of the United States Bureau of Animal Industry, Washington, D. C.; formerly instructor in physiology and vertebrate zoology in Cornell University, and in zoloogy in the Marine Biological Laboratory at Wood's Holl; author of several papers on the structure and function of the nervous system and on pharmacological subjects.

5. For assistant professor of veterinary anatomy and anatomical methods: Grant Sherman Hopkins, B. S., D. Sc., instructor in comparative anatomy and embryology in Cornell University, author of monographs on topics in comparative anatomy and histology and on methods of anatomical and physiological demonstration.

6. For professor of microscopical technology, histology and embryology: Simon Henry Gage, B.S., professor of anatomy, histology and embryology in Cornell Unisity; former chairman of the section of biology of the American Association for the Advancement of Science, and president of the American Microscopical Society; author of notes upon Histological Methods, the Microscope and Microscopical Methods; joint author of Anatomical Technology; contributor to Wood's Reference Hand-Book of the Medical Sciences, to Foster's Medical Dictionary and to various scientific periodicals and transactions.

7. For instructor in microscopy, histology and embryology: Benjamin Freeman Kingsbury, A. B., Ph. D., formerly graduate scholar and fellow in Cornell University; author of monographs on histology and upon the structure and morphology of the nervous system and organs of sense.

8. For assistant in veterinary bacteriology: Raymond Clinton Reed, Ph.D.

CURRENT NOTES ON PHYSIOGRAPHY.

RIVERS OF CENTRAL IOWA.

The annual report of the Iowa Geological Survey for 1895 contains an essay by J. L. Tilton, of Indianola, on Warren county, in the south-central part of the State, in which particular attention is given to the origin of the river courses. The small ravines are post-glacial, consequent on the slope of the surface. The larger streams follow preglacial valleys, though they have not yet cut down to the bottom of the drift that clogged their former courses. It is believed

that in Cretaceous times the chief drainage was down the faint dip of the strata to the southwest, with longitudinal subsequent branches along the strike of the weaker shales; but post-Cretaceous elevation being greatest to the northwest, the southeast-flowing subsequent streams gradually gained possession of the drainage and became the chief rivers of the region; the Des Moines being an example of this kind. Diverted consequent streams enter these masters from the northeast; headward-growing obsequent streams enter from the southwest, perhaps marking the reversed paths of former beheaded consequents; the streams of Warren county being chiefly of the latter class. Faint escarpments facing northeast are formed along the outcrops of the harder strata. The larger streams have broad flood-plained trenches below even uplands of adolescent dissection; but to cite these trenches as examples of the 'immensity of erosion' leaves no fitting term for the much greater erosion by which the generally even surface of the uplands was fashioned.

GEOMORPHOLOGY OF NORWAY.

PROF. EDUARD RICHTER gives further account of his work last summer (See SCIENCE, June 26), in his '*Geomorphologische Beobachtungen aus Norwegen*,' contributed to the Vienna Academy (Sitzungsber., Feb., 1896), from which a very clear picture of *fjeld* and *fjord* may be gained. Much importance is attached to the increased rate of weathering in the belt above the limit of vegetation and below the snow line. The plateau-like uplands are ascribed chiefly to this process, and not to peneplanation during a lower stand of the land, as advocated by some authors. The mountains of Jotunheim are regarded as unconsumed remnants of a once much greater mass, now far advanced in reduction to the upland level. Well formed cirques (*Botner*) characterize the later stages of this reduction, and many examples are mentioned in various stages of development. These forms are explained as the result of retreat by weathering back from a reëntrant on which a protective covering of névé or ice lies; and thus explained, they are regarded as trustworthy witnesses of former glacial action in various mountains of middle Europe. As a special feature of the Norwegian fiords, Richter emphasizes not only their U-shaped cross section, but also the discordance of their floor level with that of many side valleys; the steep side-wall of the deeper fiord cutting square across the floor of the shallower side valley. This is ingeniously explained as a modification of a preglacial valley system by a glaciation of just such severity as would fill some valleys with long ice streams, while certain confluent valleys of less and lower catchment area would be occupied by relatively inactive ice or only by névé. The latter valleys would then be little modified, while the former would be rapidly deepened and changed from V to U form.

This essay is of particular interest in giving a clear analysis of the relation of form to process, and in attributing much influence to the climatic control of denudation, both as determined by altitude above sea level and as affected by glacial or interglacial conditions; but the sufficiency of the process suggested for the production of the uplands needs further demonstration.

LITTLEDALE IN THIBET.

LITTLEDALE'S adventurous effort to reach Lhasa is described in an entertaining narrative with incidental mention of notable physiographic features. A number of volcanoes were seen in Thibet south of Cherchen (mid-southern border of the desert of Gobi). Thereabouts, the drainage from the mountains enters salt lakes in flat intermontane depressions of great altitude. Further southeast, rivers escape to the sea in

deep valleys and entirely change the aspect of the country. The lakes all stand lower than their ancient shore lines; many small basins of to-day having formerly united in large confluent water bodies. This narrative, like many of its class, indicates great courage and endurance on the part of the explorers, but abounds with personal incidents rather than with geographical matter. (London Geogr. Journal, May.)

DANGER FROM THUNDERSTORMS IN ARABIA.

An excursion of twelve years ago in Oman, southeast Arabia, lately described by S. B. Miles, gives once again an impressive picture of the immediate independence of desert tribes on the wadies or water courses, which determine the place of all the villages and of nearly all the roads. A canyon, six miles long and 1,000 to 1,500 deep, between neighboring valleys, was luckily passed through a day before a heavy thunder storm; less fortunate travellers are not unfrequently overwhelmed in it by the sudden rise of the stream, from which there is no escape. "The huge walls of rock give the appearance as if the mountain range had been suddenly split in twain from the base to the summit by some convulsion of nature." If a real, convulsively split canyon is some day found, what an agreeable change it will be to read: "The huge walls of the fissure formed by this convulsion of nature look just like the walls of ordinary gorges that have been slowly cut down by streams." (London Geogr. Journ., May.)

HILL ON CENTRAL AMERICA AND ANTILLES.

The May number of the National Geographic Magazine has an article by R. T. Hill on the geographic relation of the three Americas, North, Central and South, contending that the North American cordilleras terminate with the line of Mexican volcanoes west of Vera Cruz, that the Andes terminate south of the Isthmus of Panama, and that Central America is to be associated with the transverse deformations of the Antilles; the latter lying on lines of east-west corrugations "which have persisted without continental connection or union with each other since their origin." Thus interpreted, these islands belong to a class that should be welcomed by the physiographer as desiderata, long ago deduced as possibilities, and prepared for in his scheme of classification, but of rare occurrence on this small earth during the brief epoch in which we know it.

W. M. Davis.
Harvard University.

CURRENT NOTES ON METEOROLOGY.

INTERNATIONAL CONGRESS OF HYDROLOGY AND CLIMATOLOGY.

The Fourth Session of the International Congress of Hydrology, Climatology and Geology will be held at Clermont-Ferrand from September 28 to October 4 of this year. Scientific societies in all parts of the world are invited to take part in this Congress. The French railroad companies have reduced their fares 50% for those who attend the meeting, and the *Compagnie Générale Transatlantique* has given a reduction of 30% to those who travel by its steamers. Among the meteorologists who have charge of the meeting are Angot, Teisserenc de Bort and Plumandon. The list of questions to be considered in the section on climatology is the following: Meteorological observations, their part in the study of climates; What is meant by mountain climate?; Investigation on the proper means of determining the degree of clearness of the sky, of its color, and of these influences in hygiene; The prevalence of winds in certain regions, and their influence on sanitary conditions. Membership in the Congress costs 20 francs, and subscriptions may be sent to M. Doin, 8 Rue de l'Odeon, Paris.

ATLAS OF THE PACIFIC OCEAN.

A PUBLICATION of more than usual interest and importance is the large Atlas of the Pacific Ocean, recently issued by the *Deutsche Seewarte*, at Hamburg, under the direction of Dr. Neumayer. The previous volumes in the same series are an Atlas and a Handbook of Sailing Directions for the Atlantic and for the Indian Oceans. Although primarily intended for the use of ship captains, these publications should be studied by all meteorologists. The data on which the charts are based are the most complete and most authentic obtainable. The charts include among others the following: depths; ocean currents from January to March and from July to September; water surface temperatures for February, May, August and September; isotherms and isobars for the same months; winds for winter and summer; wind districts; relative frequency of winds for January, April, July and October; rainfall by districts; magnetic variation; sailing routes. For the minute study of the general meteorological conditions of the Pacific Oceans there is nothing that can approach these new German charts. The *Sailing Directions*, to accompany the *Atlas*, are now in press.

R. DEC. WARD.
HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

AMERICAN CRANIOLOGY.

PROF. HAMY, the distinguished successor to de Quatrefages, has an article in *L'Anthropologie*, for April on the Malayan and the American races. Following older authorities, he treats both as offshoots from the Mongolian variety or subspecies. When he comes to the difficult task of classifying the refractory red men he relies wholly on craniology and his results are, to say the least, sweeping. He groups as one all the mound builders, cliff dwellers and Pueblo Indians. The same group 'extends from the Atlantic to the Pacific, and from the Great Lakes to the Isthmus of Tehuantepec.' They are all brachycephalic, short in stature, with narrow noses and prominent cheek bones. It is needless to say that the researches of Boas, Virchow, Matthews and others lend no support to this statement, and indeed contradict it. Nor is Prof. Hamy's discussion of the South American skull-forms in accordance with the measurements adduced by Ehrenreich and others.

The skull is as variable among the American aborigines as it is among the Aryan nations to-day, and no classification of stocks can be founded upon it. The linguistic classification is the closest to an exact one that we can have for the race of the new world, and has been accepted by all modern American authorities.

MAN AND THE MEGALONYX.

THE Megalonyx was a hugh sloth who lived about these parts for some time after the Champlain depression of the pleistocene. His remains abound in what are are called the 'Megalonyx layers,' a horizon which Gilbert has offered evidence to place post-glacial. In these layers no trace of man has yet been found; but in April last Mr. Henry C. Mercer, exploring for the University of Pennsylvania, found in a cave in Tennessee bones of this sloth, fresh in appearance, and with remains of attached tissue and ligaments, mingled with fragments of reeds used as torches by the Indians. Along with these were other bones of living fauna, cave rats, porcupines, etc. Mr. Mercer has issued a brief announcement of this discovery, with an illustration of the bones. Copies can be had by addressing him (University of Pennsylvania, Philadelphia).

This does not necessarily remove man to remote antiquity. The sloth might have survived to comparatively recent centuries

in the mild valleys of Tennessee; but it does seem to make the red man and the animal contemporaries.

D. G. Brinton.

University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

LORD KELVIN.

The jubilee of Lord Kelvin's professorship was celebrated by the University of Glasgow, and the corporation of the city on June 15th, 16th and 17th. More than two hundred delegates were present, representing British and foreign universities and learned societies, and congratulatory messages and telegrams were sent from all parts of the globe. At a conversatzione in the University on the evening of June 15th Lord Kelvin's numerous inventions and the diplomas, medals, addresses, etc., presented to him by various scientific and other learned societies, were exhibited, and more than two thousand guests offered their congratulations to Lord and Lady Kelvin. A cablegram from the University was sent by way of San Francisco and traversed the circuit of 20,000 miles in 7½ minutes. On the morning of June 16th numerous addresses were presented to Lord Kelvin and the degree of LL.D. was conferred upon him and on several of the distinguished guests, including Prof. Simon Newcomb and Prof. Cleveland Abbe. A banquet was given by the corporation in the evening, and on June 17th there was an excursion on the Firth of Clyde.

Prof. A. Gray writes to *Nature:* "As these words are being printed, the Jubilee of Lord Kelvin's professorship is being celebrated in the most enthusiastic and magnificent manner at Glasgow. Delegates from all parts of the world are present, and among them are many of the most eminent representatives of science at home and abroad. From Paris to Moscow, Canada to Mexico, India to Australia, the whole civilized world unites in congratulating Lord Kelvin on the great work for science and the good of his fellow men which he has achieved, and in offering good wishes that he may have health and strength for the continuance of his glorious career. Though for fifty years he has been professor of natural philosophy at Glasgow, has seen pass through his classes several generations of students, has been one of the greatest leaders in what has been preëminently a century of scientific discovery and advancement, has worked as few men can work, and withal has taken the keenest interest in all that ought to interest the true citizen of a great country, yet is his eye not dim nor his natural force abated. It is the hope of all his friends and of all the great army of scientific workers who now are unanimous in doing him honor that he may have before him many long years of happy and successful work." All American men of science will join in offering their most sincere congratulations, for there is no one living when they honor more highly than Lord Kelvin.

THE TEACHING OF ANATOMY.

The last number of the *Bulletin of the Johns Hopkins University* (May–June, 1896) contains interesting accounts of the anatomical courses and laboratories of the University, including the work on normal histology and microscopic anatomy and the photographic room and apparatus. The articles are illustrated by ground plans and photo-engravings and deserve careful study by those engaged in teaching anatomy or indeed any natural science. Prof. Mall holds that anatomy should be taught in the dissecting room and not by lectures. He writes:

"I have asked many professors, even of anatomy, where they had learned their anatomy, and in nearly all cases the reply was 'in the dissecting room.' They all admitted that, in addition to demonstrations, lectures were of little use to students, and some believed them worse than useless. The zoologists and botanists have long ago learned the absurdity of the lecture method of teaching, but the anatomist patiently keeps up this slow and stupid method of instruction. It is stupid because no anatomist would use this same method if he were to learn instead of to teach.

"We know very well that the burden of responsibility is removed, to a great extent, if the instructor goes over the whole subject carefully once a year. He then can tell his student to go to the dissecting room to see for himself.

If the student does not attend the lectures, the professor carries no responsibility, no matter how uninteresting or how uninstructive they may be. Yet the beauty of the courses of lectures is that the professor carries no responsibility if the student does not know his anatomy.

"I believe that there is but one way to learn any subject, and that is through study. The very name *student* tells what the person so named should be doing; and with a natural science, dealing with a most complex object, extending through the three dimensions of space, any other method besides studying the object itself is practically useless.

"Lectures with demonstrations are certainly valuable—more valuable than the lectures with text-books alone. Yet analyzing the object itself is infinitely more valuable than to watch the results exposed by another. Wrestling with the part which is being studied, handling it and viewing it from all sides, and tabulating and classifying the parts worked out, give us the greatest reward. All this may be accomplished by practical laboratory work. If we can make the student work thoughtfully and carefully a great result is achieved. It makes of him an artist, an actor, an expert, not a dilettant. He is upon the stage, not in the audience."

GENERAL.

THE degree of LL. D. has been conferred by Harvard University on Prof. Alexander Graham Bell, of Washington; on Prof. William R. Ware, of Columbia University, and on Prof. William G. Farlow, of Harvard University; by the University of Michigan on Prof. E. L. Mark, of Harvard University, and by Amherst College on Prof. C. H. Hitchcock, of Dartmouth College.

THE discovery of Rayleigh and Ramsay is being extended into unexpected fields of research. Wm. Schlœsing (fils) and Jules Richard have recently read before the French Academy a paper in regard to researches upon Argon in the gas within the swim-bladders of fishes.

THE national collection of plants placed many years ago by the Smithsonian Institution in the custody of the Department of Agriculture has been returned to the Institution by Secretary Morton, who is unwilling longer either to be responsible for work in botany, except as related directly to agriculture, or to keep so valuable a collection in a building which is not fire proof. It is now arranged in the east balcony of the National Museum building. The following members of the museum staff are assigned to the Department of Plants: Curator of Plants, (Honorary) Mr. F. V. Coville, Botanist of the Department of Agriculture. Assistant Curators, Dr. J. N. Rose, Mr. O. F. Cook, Mr. Charles Louis Pollard. Aid, Mrs. Carrie Harrison. Clerk, Miss Flora N. Vasey. Mounters, Mrs. Anna T. Moore, Miss Louise Zimmerman, Miss Frederica Wernheimer, Miss L. V. Schaeffer. Messenger, Felix Moore.

AN International Congress of Maritime Fisheries, Oyster culture and Marine Agriculture will be held September 3d to 7th at Sables d'Olonne, in Vendée, under the auspices of the Society *L'Enseignement Professionnel et Technique des Pêches Maritimes*. M. E. Perrier, of the Institute, professor in the Museum of Natural History in Paris, will preside.

Observations sur les prestidigitateurs by Joseph Jastrow, an article translated from SCIENCE, appears in the *Revue Scientifique* for June 20th.

PROF. S. P. LANGLEY sailed for Europe on July 8th, for a two months' stay.

DR. C. A. DOREMUS, of New York City, has been appointed, by the Secretary of State, delegate from the United States to the International Congress of Applied Chemistry in Paris.

Garden and Forest states that the old home of the naturlist Audubon, in Pennsylvania, is on the south bank of the little River Perkiomen, about three miles to the eastward of Phœnixville. The house, which is locally famous as the Mill Grove House, was built nearly a century and a-half ago, and stands on a knoll which affords a fine prospect. It is of stone, solid and substantial, thickly overgrown with ivy and shadowed by a number of tall pines, under the branches of which Audubon produced some of his best work. In spite of certain interior changes, the chimney-corner where his studying was done still remains as he knew it.

The New York *Evening Post* states that some changes in the competitive system of appointment as related to the scientific bureaus of the Department of Agriculture are now under consideration, and may be announced in a few days. The system of special examinations for scientific positions has not proved satisfactory. It is said that besides being troublesome and expensive these examinations put a premium upon the narrowly educated specialist and do not sufficiently recognize experience and intellectual breadth. The reforms proposed are a permanent list of eligibles, based on lines of broader scientific training and a longer period of apprenticeship for those who are taken into the scientific bureaus, so that the higher positions need never be filled directly from the special examination, but by promotion on basis of examination of tried assistants.

D. Van Nostrand & Co. announce for publication in August a work on *Röntgen Rays and Phenomena of the Anode and Cathode*, by Edward P. Thompson, assisted by Louis M. Pignolet, N. D. C. Hodges and Ludwig Gutmann, with a chapter on Generalizations, Arguments, Theories, Kindred Radiations and Phenomena, by Prof. Wm. A. Anthony.

The next meeting of the American Microscopical Society will be held at Pittsburg, Pa., August 18, 19, 20, 1896, under the presidency of Prof. A. Clifford Mercer, of Syracuse, N. Y. The meeting, which promises to be of special interest, will be held in the Carnegie Library Building. It is hoped that there will be a full attendance of members, as the question of having a permanent home in which the accumulated property of the Society is to be considered. Membership blanks and general information regarding the Society may be obtained from the Secretary, Prof. W. C. Krauss, 382 Virginia street, Buffalo, N. Y.

The United States Civil Service Commission will hold an examination in Washington and other cities where there are applicants, on July 30th, to fill a vacancy in the position of assistant in the division of chemistry, Department of Agriculture, at a salary of $1,200 per annum; also an examination on August 13th and 14th to fill a vacancy in the position of botanical artist, Department of Agriculture, at a salary of $1,000 per annum.

Mr. Flinders Petrie has been appointed executor-in-chief of the Egypt Exploration Fund, and the work will doubtless be prosecuted with vigor under his administration.

William T. Brigham, of Honolulu, left for Washington June 26th, to visit the Smithsonian Institution. He is director of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History at Honolulu, left the latter place last Janurry, and has been making a tour around the world for the purpose of studying the chief ethnological exhibits in various countries. He has been especially interested in studying the marine zoological stations at Naples, Berlin, Amsterdam and Portsmouth, as he expects to organize a marine zoological station near Honolulu for the Hon. Charles R. Bishop, Vice-President of the Bank of California. The proposed new station, he says, will cost three-quarters of a million dollars.

We learn from the *Revista de la Instrución Pública Mexicana* that a law is being considered by the Mexican Chamber of Deputies making all the archæological monuments and remains in the country the property of the nation and forbidding their exploration, restoration and removal without express authorization of the executive. The archæological map of the republic is to be revised, the monuments are to be examined, and as much of the material as possible is to be preserved in the National Museum. It is to be a penal offence to injure the remains or to export them from the country without legal authorization.

Sir John Evans has presented to the London Geological Society an oil portrait of Huxley.

The steam yacht Ohio sailed for Norway on June 27th, with two hundred passengers, including a number of men of science, to observe the total eclipse of the sun at Bado.

In order to encourage kite-designing and kite-flying, the Boston Aëronautical Society offers for the best kites, cash prizes amounting to one hundred and fifty dollars. The competition is to take place between September 15 and October 15, 1896. Octave Chanute, Esq., offers, through this Society, a special prize of one hun-

dred dollars for the best Monograph on the Kite, giving a full theory of its mechanics and stability, with quantitative computations appended. Further information may be obtained from the Secretary, Mr. A. A. Merrill, P. O. Box 1197, Boston, Mass.

MR. ROBERT M. PIRS, 320 E. 14th street, New York, will, beginning with July, edit and publish a quarterly journal entitled *Journal of Communication*, devoted to linguistic, metric and numeric progress.

THE *Atlantic Monthly* for July contains an interesting article by Mr. John Fiske, entitled 'The Century's Progress in Science.'

MAJOR J. W. POWELL will be engaged during the summer on a scientific expedition to the coast of Maine, for the purpose of studying the shell mounds.

WE learn from *Nature* that a preliminary meeting has been held in Liverpool for the purpose of taking steps for the establishment in that city of a Zoological Garden on a scientific basis, and on the model of that in Regent's Park, London. On the motion of Prof. Herdman, seconded by Dr. Forbes, the following resolution was unanimously adopted: "That in the opinion of this meeting it is desirable, in the interests of science and education in this city, to establish Zoological Gardens, containing a collection of living animals, and that those present form a committee, with power to add to their number, for the purpose of advancing this object." The question of a site was considered, and it appeared that there was just now a favorable opportunity of securing land in a central position very suitable for the purpose. It was resolved that the following gentlemen be asked to form a sub-committee to inquire fully into the matter and prepare a report: Prof. Herdman, Dr. Forbes, Messrs. A. L. Jones, A. A. Paton, A. S. Hannay, W. H. Picton, W. E. Willink, F. J. Leslie and F. Radcliffe.

THE Macmillan Co. will issue shortly an Elementary Solid Geometry by Prof. Henry D. Thompson, of Princeton University.

THE Council from the London Mathematical Society has awarded the De Morgan Medal to Mr. Samuel Roberts.

IN a paper presented before the London Physical Society on June 12th Prof. S. P. Thompson stated that he had been unable to obtain true reflection of the Röntgen rays, though most bodies, including air, gave diffuse reflection.

LORD KELVIN calls our attention to the fact that in a letter to the London *Times*, subsequent to the one quoted in our issue of May 22d, he added the sentences: "The weight of a cubic mètre of water is a French ton. The cubic decimètre of waters weighs a kilogramme, the cubic centimètre, a gramme." These sentences may be added at the middle of the second line at the top of the second column of page 166 of the last volume of this JOURNAL.

THE *International Medical Magazine* for June contains articles on X-ray photography in its application to medicine by Prof. Arthur W. Goodspeed, Prof. W. W. Keane and Dr. Thomas G. Morton. The articles are illustrated by ten full-page plates showing the details of the skeleton in health and disease with remarkable clearness. In the photographs of the trunk and pelvis taken by Prof. Goodspeed, the cervical vertebræ, the articulations of the shoulder joint, etc., are shown with as great clearness as the bones of the hand in the earlier experiments.

THE bill permitting the use of horseless carriages on highways in Great Britain has passed the House of Lords, but it is feared that the pressure of business before the House of Commons will prevent the bill from becoming a law before the vacation. In the meanwhile several companies have been incorporated for the manufacture of horseless carriages, one with a capital of $5,000,000.

UNIVERSITY AND EDUCATIONAL NEWS.

THE University of Vermont dedicated, on June 23d, two new buildings, Converse Hall, a dormitory presented to the University by John H. Converse at a cost of $125,000, and a science building presented by Dr. Edward H. Williams which, with its equipment, will cost about $200,000. The dormitory was formally presented to the University by Mr. Converse,

and the science building, in the absence of Dr. Williams, by his son, Prof. Edward H. Williams, jr., of Lehigh University. The latter building, designed by Messrs. Wilson Brothers, of Philadelphia, has a front of 175 ft. and a depth of 53 ft., with a wing in the rear 51 × 49 ft., and is built of brick and terra cotta on a basement of granite. On the front are three medallions with the heads of Agassiz, Henry and Prof. Marsh. The building contains ample accommodations for the departments of physics, chemistry, biology, electrical engineering and metallurgy.

THE Butterfield Museum of Dartmouth College has been completed, and the departments of geology, zoology and botany have been removed to the new building.

THE New York University is about to erect a building to be used as a geological museum and library. It is to be one story in height, of rubble stone and brick, and is expected to cost about $50,000.

THE Johns Hopkins University conferred this year the degree of Bachelor of Arts on 37 candidates and the degree of Doctor of Philosophy on 31 candidates. The following candidates presented theses in the sciences coming more especially within the scope of this JOURNAL: A. D. Chambers, An Investigation of the Composition of Certain Oxides of Maganese; F. S. Hollis, On the two Clorides of Nitro-orthosulphobenzoic acid; E. Mackay, A Contribution to the Study of Double Salts in Water Solution; R. M. McKenzie, Some Double Clorides of Ferric and of Ferris Iron with some Aromatic Bases; M. D. Sohon, An Investigation of Some Derivatives of Orthosulphobenzoic Acid; E. F. Gallaudet, Relations between Length, Elasticity and Magnetization of Iron and Nickel Wires; B. M. Roszel, The Action of the Asteroids on Mars; H. A. Sayre, On the Generation of Surfaces by the Motion of Plane Curves; T. H. Taliaferro, The Congruensis formed by the Tangents to the Lines of Curvature of a Given Surface; G. O. Smith, The Geology of the Fox Islands, Me., A. C. Spencer, The Geology of Massanutten Mountain, Va.; H. M. Nower, The Embryology of the Termite; G. Lefevre, Budding in Perophora.

OF the twenty-one fellowships this year awarded at the Johns Hopkins University, we note the following: *Physics*, N. E. Dorsey, W. T. Mather, J. F. Mohler; *Chemistry*, W. E. Henderson, C. D. Ragland; *Biology*, H. L. Clark, D. S. Johnson; *Mathematics*, A. Pell; *Pathology*, E. P. Carter; *Geology*, G. B. Shattuch.

PROF. C. D. WOODS has been elected Director of the Maine State College, at Orono, in the place of Prof. W. H. Jordan, who has been elected Director of the New York Experiment Station, at Geneva.

THE following public lectures will be given in connection with the Harvard University summer school from July 3d to August 14th:

July 7, 'University Study of Education and Teaching,' Prof. Paul H. Hanus. July 9, 'The Fine Arts in Elementary Education,' Prof. C. E. Norton. July 14, 'The Teaching of the Modern Languages: Aims, Means and Methods,' Prof. Hugo K. Schilling. July 16, 'Rational vs. Empirical Geography,' Prof. Wm. M. Davis. July 21, 'Certain Peculiarities of Australasian Vegetation; Illustrated by Stereoptican Views,' Prof. Geo. L. Goodale. July 23, 'The Teaching of Physical Science: Aims, Means and Methods,' Mr. Joseph Y. Bergen. July 28, 'Military Drill in the Public Schools,' Dr. D. A. Sargent. July 31, 'Psychology and Relaxation,' Prof. Wm. James. August 4, 'The Teaching of English: Aims, Means and Methods,' Mr. Byron S. Hurlbut.

DISCUSSION AND CORRESPONDENCE.

THE FORM OF THE HEAD AS INFLUENCED BY GROWTH.

TO THE EDITOR OF SCIENCE: I was much interested in Dr. W. Z. Ripley's contribution on the question of the growth of the head which appeared in the issue of June 19th, of SCIENCE. The author's observation that the cephalic index of Americans decreases with increasing age is certainly correct, but I think the contrary observations of European investigators admit of an interpretation different from the one given by Dr. Ripley, who is inclined to believe that in long-headed races the index decreases with increasing age, while in short-headed races it increases with increasing age. The European material seems to me hardly adequate to form a far-reaching conclusion of this kind.

Zuckerkandl based his conclusions that children have more elongated heads than adults on measurements of 156 children and 197 adults from the interior parts of Austria. But in selecting these individuals he excluded what he calls the Slavic type, including only the elongated heads which he ascribes to the Teutonic type. This arbitrary selection makes the results of his comparison of doubtful value for a treatment of the question of growth; Zuckerkandl discusses this point at length and points out that his statistics must not be considered final. (*Mitt. der Anthrop. Ges. in Wien* XIV. 1884, p. 127.)

Holl has based his statement on the measurement of only 16 skulls of children, and consequently no weight can be attached to it.

Mies to whom Dr. Ripley refers does not make—so far as I can make out—any statement in regard to the question at issue in the passage quoted (ibid. XX. 1890, p. 39 ff.).

The statistics of Dr. Livi which were published in the *Archivio per l'antropologia e la etnologia*, 1886, p. 235, are based on observations by Calori, Brennsohn, Waldhauer, Wæber and Broca; but they are classified in two groups: of more and of less than 33 years of age, and can therefore not be utilized for treating the question of the influence of growth upon the form of the head, as they are rather directed to detecting retrogressive changes which begin after the 35th year of life.

While these European data are open to serious objections, we find in America that with few exceptions long-headed tribes as well as short-headed ones, show a decrease in the value of the cephalic index with increasing age. I have compiled the following table in order to make this point clear:

CEPHALIC INDEX OF

Tribe.	Adults.	Children.	Difference.
Micmac.....	79.0 (136)	80.9 (84)	+ 1.9
Eastern Ojibwa...	81.8 (396)	81.6 (309)	— 0.2
Cherokee...	82.0 (140)	81.0 (75)	— 1.0
British Columbia...	83.6 (284)	85.3 (138)	+ 1.7
Moqui	84.0 (116)	86.4 (77)	+ 2.4
Navajo.....	84.2 (77)	86.8 (76)	+ 2.6

The cause for this decrease is not far to seek. With maturity the frontal sinuses and the occipital protuberance begin to grow, particularly in males, while there is no corresponding local growth on the parietal or temporal bones. This has the effect that the length grows more rapidly than the breadth and that the index begins to decrease. The lesser development of the frontal sinuses and of the occipital protuberance in women is also a sufficient explanation for their greater brachycephalism.

Nevertheless, I believe that the breadth of the head increases as long as the length, although at a slower rate, and that Dr. Ripley would have obtained this result if his series had been more extensive. I cannot find that Schaafhausen, who held this opinion, has substantiated it by any extensive series of observations. The best series that is available is that of Dr. Venn (*Jour. Anthrop. Institute.* XVIII., p. 152, ff.) which when arranged from this point of view gives the following results:

Year.	Length of Head. Inches.	Breadth of Head. Inches.	Index.	Individuals.
19	7.54	5.87	77.9	139
20	7.57	5.93	78.3	305
21	7.58	5.93	78.2	248
22	7.63	5.98	78.4	189
23	7.54	5.97	79.2	83
24	7.71	6.03	78.2	52
+25	7.62	6.00	78.7	79

But the growth of the head does not close with the twenty-fifth year. The following table shows that among the Indians it continues to grow until near the thirtieth year, and the period will certainly not be found shorter among people of European descent, while it may be shorter among the negroes:

Years.	Length of Head.
20–21	193.0 mm.
22–23	193.7 "
24–25	193.8 "
26–27	194.3 "
28–29	194.8 "
30 and more	194.8 "

FRANZ BOAS.

NEW YORK.

BIOLOGY, ZOOLOGY AND BOTANY.

TO THE EDITOR OF SCIENCE: Prof. Conway MacMillan, who claims (SCIENCE, III., p. 634) to have single-handed banished a 'sham

biology' from two of our leading universities, still has work to do. As Prof. Brooks tells us (SCIENCE III., p. 708), the Johns Hopkins University had not in the twenty years of its history examined a candidate for the doctorate in 'biology.' Yet this year, perhaps as a declaration of independence from the influence of Prof. MacMillan, it has conferred the degree of Doctor of Philosophy on a candidate who chose 'biology' as one of his subjects.

Questions of nomenclature seem to be more interesting to the botanist than to the zoologist, and it is not the present writer's intention to discuss this one. But the occasion seems favorable for asking Prof. MacMillan why it is that zoology has become to such a large extent synonymous with biology. Is it not, perhaps, because the zoologist is usually a biologist, whereas the botanist is usually only a botanist? The great advances which, during the past forty years, have transformed biology, have come almost exclusively from the side of the zoological sciences. Zoologists have not hesitated to use botany when they could, but in the advancement of biology, botany, even as a silent partner, does not seem to have contributed its share of capital. Y.

AN UNCOMMON AFTER-IMAGE.

SOME days since, while traveling by boat, I awoke in the early morning, and, thrusting my head out of the window, was almost overpowered by the yellow glare. I then raised the blind with its yellow horizontal slats, and for a moment noticed the glare pouring through them. Then, shutting my eyes, I had for a few seconds an after-image of some half-dozen *vertical* green lines gradually fading away into *vertical* violet lines.

HIRAM M. STANLEY.

MACKINAC ISLAND, June 20.

THE NINE-BANDED ARMADILLO.

TO THE EDITOR OF SCIENCE: In his recent paper, in the *Bulletin of the American Museum of Natural History*, on mammals collected in Bexar County and vicinity, Texas, Prof. Allen refers to the capture of specimens of the nine-banded armadillo at several places north and west of Bexar County, but mentions none from that county. It may be of interest, therefore, to note that five specimens were taken in the county in May, 1895, about four miles from San Antonio. There were two adults and three young, all captured immediately after a heavy rain which had driven them from their burrow. This family of armadillos was presented by Mr. F. Hardman, of San Antonio, to the National Zoological Park in this city, where two of its members may still be seen, apparently in excellent health.

A. B. BAKER.

WASHINGTON, D. C., June 22, 1896.

ROCHEFORT ON THE CARIBBEANS.

TO THE EDITOR OF SCIENCE: Appropos of the wonderful explorations of Mr. Frank Hamilton Cushing and his party in San Marco, Florida, last winter, under the auspices of the University of Pennsylvania, I would call attention to the following sentence in Rochefort (Caribby Islands, London, 1666, p. 291). Speaking of the Caribbeans he says: "Their Habitations are somewhat near one to another, and disposed at certain distances after the manner of a Village; and for the most part they plant themselves upon some little ascent, that so they may have better air and secure themselves against those pestilent flies which we have elsewhere called *Mosquitos* and *Maringoins*, which are extreamly troublesome, and whereof the stinging is dangerous in those parts where there is but little wind stirring. The same reason it is that obliges the *Floridians*, beyond the bay of *Carlos* and *Tortugues*, to lodge themselves for the most part at the entrance of the Sea in Huts built on Piles or Pillars."

O. T. MASON.

U. S. NATIONAL MUSEUM, July 2, 1896.

SCIENTIFIC LITERATURE.

Handbuch der paläarktischen Gross-Schmetterlinge für Forscher und Sammler. Zweite gänzlich umgearbeitete und durch Studien zur Descendenztheorie erweitete Auflage, etc. VON DR. MAX STANDFUSS, mit 8 lithographischen Tafeln und 8 Textfiguren. Jena, Gustav Fischer, 1896. 8°. Pp. 392.

This is much more than an ordinary handbook for the lepidopterist, since it comprises a

great deal of new matter relative to the hybridization and seasonal dimorphism of Lepidoptera, the result of some twenty-five years of work. It is therefore a most important contribution to biology, and is another in the series of notable works called out by the epoch-making essays of Weismann contained in his 'Studies in the Theory of Descent,' published over fifteen years ago, when the author was an orthodox Lamarckian.

The practical topics discussed relate to the mode of collecting, the breeding of larvæ, including pairing of the sexes of the same and of different species. This portion is succeeded by lengthy accounts of certain special cases of hybridization and of hybrids between different European species of Saturnia, with details regarding the biological, anatomical and physiological peculiarities of the hybrids, including a very neat and obviously correct phylogeny of the genus as concerns the European species. This part is followed by generalities on hybridization and hybrids, and on pairing both in confinement and in nature.

The egg-state, larva and pupa, their care, artificial hibernation, diseases, etc., are fully treated from the point of view of one who has reared thousands of specimens in the most successful, careful and scientific manner.

Next to the subject of hybridization that of seasonal dimorphism as discussed by Standfuss is of special value, since he brings forward many new facts. It is treated under the following heads: Albinism, melanism, change of color, exchange of colors, local races, local forms, local varieties, seasonal dimorphism, based on experiments on butterflies (species of Papilio, Rhodocera, Vanessa, Argynnis, and on a moth, *Dasychira abietis*.

The paper succeeding, devoted to thoughts relative to the question of species-formation, contains the author's general views, and the book ends with the directions for collecting the imagines.

It would have been better, we think, if Dr. Standfuss had divided the work into two parts, separating the practical directions from the scientific part, but the result will be that the amateur and collector will be perhaps, in some cases at least, insensibly led to become a scientific observer, and thus great good will result in placing the study of insects on a higher plane.

The results of the experiments in keeping the pupa of *Papilio Machaon* at a temperature of 98–99° F. produced not only changes in markings and hue, but also in form, such as the lengthening of the 'tail,' while the specimens were lighter in color, some bearing a perfect resemblance to those that fly in August, near Antioch and Jerusalem. On the other hand, the pupa subjected to cold gave out butterflies which resembled the Swiss and German forms emerging from hybernated chrysalids. The experiments were numerous and confirm the earlier results obtained by Weismann, W. H. Edwards, Merrifield and others.

Dr. Standfuss is a neo-Lamarckian, believing that, as the result of his experiments, seasonal and local varieties or species are the result of direct changes in the environment—a logical conclusion from the facts. And if this is the case in the laboratory it logically follows that it must be so in nature, especially where isolation occurs. His observations afford him proof of the inheritance of acquired characters. He states that the results of his experiments on the effects of change of temperature render it impossible to bring them into harmony with the views of Weismann, and he is in accord with the conclusions of Eimer as to the direct influence of the environment and of the inheritance of acquired characters in species-building. He thinks that natural selection is limited in its operation, many species having originated and become established without its aid. Finally, he gives us the following definition of the idea of a species: "Species are groups of individuals which, through the direct influence of certain factors of the external world, have diverged so far from the nearest allied types that they can no more cross with these in their sexually developed forms; that the completely developed offspring resulting from this crossing, should it occur, are absolutely incapable of breeding with one another."

It is to be hoped that an English translation of this important work may be published, so as to infuse a more scientific spirit into the minds of the many who are interested in the collection

and rearing of Lepidoptera. The plates are most excellent and add greatly to the interest and value of the book.

A. S. Packard.

A Compendium of General Botany. By Max Westermaier. Translated from the German, by Albert Schneider. New York, John Wiley & Sons.

In the preparation of the English edition of this book the translator has endeavored, as stated in his preface, to 'adhere as closely as possible to the author's form, style and concept of the science of botany,' and 'to make it a translation in the true sense of the word.' The title of the German edition, 'Kompendium der allgemeinen Botanik für Hochschulen,' indicates that the work was intended for the higher grade of institutions in Germany, *i. e.*, for the universities; and so, in the translation of the author's preface, the literal rendering of the word 'Hochschulen' as 'high school' in this country is misleading as to the place which the book was intended to occupy. That the book was not intended for the high school, as that term is used in this country, can be seen from even a hasty examination of the text, and the preface states that "it is assumed that the pupil has a general knowledge of chemistry, of physics, of the proper use of scientific terminology, and has the ability to estimate the value of hypotheses and undecided problems."

A similar notion of the *Hochschule* caused adverse criticism to be made of the German edition, as being too technical and advanced for the 'high school.'

The work is divided into five parts which treat of the following topics: The cell, tissues and simple organs, organs and systems of organs, reproduction, the general chemistry and physics of plant life, classification of plants, taxonomy.

In Part I., the cell, the author treats of the primordial utricle and cell wall in their mutual relationship, turgor, plasmolysis, both the living and dead inclusions of the cytoplasm, as well as the cell sap, etc., the internal structure and method of growth of the cell wall, its chemical composition, subsequent changes, and the products of growth in thickness and surface of the cell walls. The chemical and physical aspects of the cell and its contents are treated more fully than the phenomena of the active cell, indirect division of the nucleus being passed by with a few illustrations and very brief descriptions of the stages represented.

Part II., tissues and simple organs, has received greater consideration than any other part of the subject, 107 pages being covered in the discussion, which with the 37 pages devoted to the Cell make 144, or more than one-half of the entire work. This part is divided into eleven chapters as follows: 1st, the function of formative tissues (meristum and cambium); 2d, structure and function of the epidermal tissue system; 3d, function of mechanical tissues; 4th, the function of the conducting system; 5th, protection of the meristematic areas of the plant body; 6th, food substances derived from the atmosphere; 7th, the function of aeration; 8th, the function of roots; 9th, the appropriation of assimilated food substances; 10th, the storing and function of reserve material; 11th, secretion.

Under the function of the conducting system a full discussion is given of the various cell forms of the system, the stem structure of mosses, vascular cryptogams, monocotyledons, dicotyledons and gymnosperms, the structure of roots, and the special physiology of the movements of food substances and water in plants.

Part III., organs and systems of organs, treats of the morphological and physiological relations of organs, their principal forms and modifications, metamorphosis, correlation, phyllotaxy, and the various kinds of inflorescence.

Part IV., reproduction, receives very brief mention, being merely an outline, with illustrations, of the development and reproduction of representative plants in the larger groups, the morphology and physiology of the seed and fruit of phanerogams, the general physiology of reproduction, pollination, hybridization, heredity, special creation and the 'so-called theory of natural descent.'

Part V., the general chemistry and physics of plant life, includes chemical physiology, the physiology of growth, the relation of light, gravity and other factors to plant life, and the physiology of plant movements.

It will be observed that the book differs greatly from most books on general botany in the great emphasis laid on the chemistry, physics and physiology of plants, less stress being put on the morphology and development. This is in accordance with what we should judge to be the taste of the author, who was long a pupil of Schwendener. In the general treatment of the subject-matter the author makes frequent use of and reference to the works of Naegeli, Sachs, Pfeffer, de Bary, Frank, Goebel and Warming, but more especially to those of Schwendener, Haberlandt and others of Schwendener's pupils. For this reason the book will be a welcome addition as a condensed reference book of the work of these investigators.

The author is a fervent disciple of the idealistic school of special creation, and accepts only those processes to be governed by natural law which have been revealed by scientific investigation as facts. Relationship and relative position of groups of plants is, in the mind of the author, only "a process of thought which the comparative study of the plant series creates in our minds; that such a series is genetic is an unverified postulate of the dogmatic teaching of descent, which allows fantasy to supplant that which empirical investigations leave unanswered." Hypnotized by the fathomless depth of life, he accepts the miraculous creation, under the influence of which the mind is closed to the philosophical consideration of fundamental relationships and modes of progress as suggested by phylogenetic evolution, and it does not appear to be realized that God working through natural law, and by processes of evolution through time, has developed the universe in accordance with the same plan which is wonderfully shown in the ontogeny of the present.

GEO. F. ATKINSON.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

THE July number opens with an article by Carl Barus, describing the lecture-room experiment with carbon dioxide, showing the passage of the liquid through the critical temperature. Suggestions are given in regard to the arrangement of the tube with respect to the sunlight used for illumination and the projecting lens, in order to give the best results. The experiments performed by the author seem to prove that there is no "real continuity between CO_2 gas and CO_2 liquid at the critical temperature. There is continuity between the liquid and *a gas which preserves the same molecule*, the same molecular structure as the liquid from which it issues. Doubtless at still higher temperature the gas with the liquid molecule will break up into the true gas with the gaseous molecule."

H. H. Clayton discusses in detail the question of a seven-day weather period. The investigation, the results of which are here detailed, was carried on under the auspices of the Elizabeth Thompson fund, and is a continuation of an earlier work by the same author, published in the *Journal* for March, 1894. In all, twenty-one stations were selected for the discussion; three in the Arctic regions, four in the United States, five in Europe, two in Asia, two in Oceanica near the Equator, three in middle South America, one in Mauritius, and one in Australia. The results of the investigation show that in general there are two maxima and two minima frequencies during the seven days, and at some stations there appear to be three. Charts are introduced showing the progression of these periods around the world. The author regards this department of investigation as a promising and important one in connection with weather forecasting, since "it is possible to say that in all parts of the world barometric minima will be from 10 to 20 per cent. more frequent on certain days than on certain other days, provided the interval taken is sufficiently long. It is also possible to say that certain days will average colder than other days."

S. L. Penfield describes a sulpharsenite of silver, Ag_9AsS_6 or $9Ag_2S$, As_2S_3, analogous to polybasite Ag_9SbS_6, to which the name pearceite is given. He calls attention to the fact that arsenical varieties of the species polybasite have long been recognized, but regards it as advisable that they should be grouped together as an independent species, in accordance with the general method of distinguishing between the antimonial and arsenical members of this series of minerals. The pearceite here described was

from a mine at Marysville, Montana, which has not only yielded material admitting of excellent analyses, conforming to the theoretical composition, but also beautiful crystals. These crystals are shown to belong to the monoclinic system, with an angle of inclination differing but little from 90°, and a rhombohedral symmetry in the distribution of the faces. In connection with this investigation the crystalline form of polybasite was also studied, particularly on specimens from Colorado; and it is shown that they also are monoclinic with the same habit as that which characterizes the pearceite. An interesting summary of a number of metallic species among the sulphides, which have a prismatic angle of nearly 60°, is given.

James L. Greenleaf describes in considerable detail the hydrology of the Mississippi. The special points considered are the volume, flow, the annual rainfall and its distribution, and the relation of flow or run-off to the rainfall, as depending upon the special conditions present in a particular case. The discussion is based upon a report by the writer upon certain water powers prepared for the tenth census. The data there given have been amplified to cover the flood and low water as well as the average discharge of the Mississippi and its tributaries, and have been brought up to date by a study of the subsequent gaugings conducted by the corps of engineers. A series of diagrams present the data graphically and give basis for further discussion. The first gives the average discharge for the different tributaries with their branch areas. Another diagram shows the average flow and rainfall, and still another connects the high average and low discharge and rainfall for the upper and lower Mississippi and for the principal branches.

C. R. Eastman describes the relations of certain body plates of the Dinichthyids. The subject of Tertiary floras of the Yellowstone National Park is enlarged upon by F. H. Knowlton. His paper belongs with that on *The Age of the Igneous Rocks of the Yellowstone* by Arnold Hague, published in the June number. The region is shown to be remarkably rich in species, and three distinct flora are distinguished. The first is referred to the Fort Union or Lower Eocene; a second is regarded as Miocene, but older than the auriferous gravels, and the third is regarded as Upper Miocene. The entire flora embraces 147 forms, distributed among 33 natural orders. The remarkable contrast between the richness and variety of the vegetation at that time with the comparative paucity at present, and the bearings of this upon the change in climate, are brought out. The whole subject will be developed in detail in a monograph to be published under the auspices of the United States Geological Survey. O. C. Marsh describes a remarkable specimen of a Belodont reptile found in the red sandstone of the New Haven region. His paper is accompanied by a plate showing the portion of the back of the reptile which is preserved. A. E. Verrill gives an article on a new cephalopod of the genus *Opisthoteuthis*, illustrated by a number of figures. Remarks are added on the general subject of molluscan morphology. The subject of separation or isolation in its bearings on geology and zoography is discussed by A. E. Ortmann. He finds in it an explanation of the distribution of animals as well as of the origin of species. T. L. Walker gives observations on percussion figures in mica, and shows that, contrary to what has been hitherto held, the angles between the lines developed are not 60°, but vary somewhat widely from this. I. K. Phelps describes an iodometric method for the determination of carbon dioxide.

PSYCHE, JULY.

R. A. Cooley describes and figures on a plate a new structural character in insects, consisting of a 'spiny area,' a small patch of short sharp spines on the under side of the fore wing near the base posteriorly, related to a corresponding patch on the thorax, at the point which the spines touch when the wings are in repose. He has demonstrated its presence in nearly five hundred moths, all of which fold their wings over the abdomen, and also in some insects of other orders. W. S. Blatchley continues his notes on the winter Coleoptera (sixty species) of Vigo Co., Ind., and A. P. Morse his notes the Tryxalinæ of New England, the new genus Clinocephalus being considered. Brief notes on butterflies are given by Miss Soule and Messrs. Folsom and Symthe.